

Guidelines for the management of traumatic dental injuries



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The guidelines represent the current best evidence based on literature research and professional opinion. As is true for all guidelines, the health care provider must apply clinical judgment dictated by the conditions present in the given traumatic situation. The IADT does not guarantee favorable outcomes from following the Guidelines, but using the recommended procedures can maximize the chances of success.

Introduction

The Guidelines contain recommendations for diagnosis and treatment of specific traumatic dental injuries using proper examination procedures:

A. Clinical Examination.

Information about examination of traumatic injuries can be found in a number of current textbooks ¹².

B. Radiographic examination

As a routine, several angles are recommended:

1. 90° horizontal angle, with central beam through the tooth in question

1 Andreasen JO, Andreasen FM, Andersson L. Textbook and color atlas of traumatic injuries to the teeth. Fourth Edition. Copenhagen, Munksgaard, 2007.

2 Andreasen JO, Andreasen FM, Bakland LK, Flores MT: Traumatic dental injuries. a Manual. Second Edition Copenhagen, Munksgaard, 2003.

2. Occlusal view
3. Lateral view from the mesial or distal aspect of the tooth in question

C. Sensibility tests

Sensibility testing refers to tests (electric pulp test or cold test) to determine the condition of the tooth pulp. Initial tests following an injury frequently give negative results, but such results may only indicate a transient lack of pulpal response. Follow-up controls are needed to make a definitive pulpal diagnosis.

D. Patient instructions

Good healing following an injury to the teeth and oral tissues depends, in part, on good oral hygiene. Patients should be advised on how best to care for teeth that have received treatment after an injury. Brushing with a soft brush and rinsing with chlorhexidine 0.1% is beneficial to prevent accumulation of plaque and debris.

Treatment guidelines

1. Treatment guidelines for fractures of teeth and alveolar bone

Uncomplicated crown fracture

Complicated crown fracture

Crown-root fracture

Root fracture

Alveolar fracture

2. Treatment guidelines for luxation injuries

Concussion

Subluxation

Extrusive luxation

Lateral luxation

Intrusive luxation

3. Treatment guidelines for avulsed permanent teeth

Avulsed tooth with a closed apex

Avulsed tooth with an open apex

PERMANENT TEETH

1. Treatment guidelines for fractures of teeth and alveolar bone

Uncomplicated Crown Fracture

Clinical findings	Radiographic findings	Treatment
Fracture involves enamel or dentin and enamel; the pulp is not exposed. Sensibility testing may be negative initially indicating transient pulpal damage; monitor pulpal response until a definitive pulpal diagnosis can be made.	The 3 angulations described in the Introduction to rule out displacement or fracture of the root. Radiograph of lip or cheek lacerations is recommended to search for tooth fragments or foreign material.	If tooth fragment is available, it can be bonded to the tooth. Urgent care option is to cover the exposed dentin with a material such as glass ionomer or a permanent restoration using a bonding agent and composite resin. Definitive treatment for the fractured crown may be restoration with accepted dental restorative materials.

Complicated Crown Fracture

Clinical findings	Radiographic findings	Treatment
Fracture involves enamel and dentin and the pulp is exposed. Sensibility testing is usually not indicated initially since vitality of the pulp can be visualized. Follow-up control visits after initial treatment includes sensibility testing to monitor pulpal status.	The 3 angulations described in the Introduction to rule out displacement or fracture of the root. Radiograph of lip or cheek lacerations is recommended to search for tooth fragments or foreign material. The stage of root development can be determined from the radiographs.	In young patients with immature, still developing teeth, it is advantageous to preserve pulp vitality by pulp capping or partial pulpotomy. This treatment is also the choice in young patients with completely formed teeth. Calcium hydroxide and MTA (white) are suitable materials for such procedures. In older patients, root canal treatment can be the treatment of choice, although pulp capping or partial pulpotomy may also be selected. If too much time elapses between accident and treatment and the pulp becomes necrotic, root canal treatment is indicated to preserve the tooth. In extensive crown fractures a decision must be made whether treatment other than extraction is feasible.

Crown-Root Fracture

Clinical findings	Radiographic findings	Treatment
Fracture involves enamel, dentin and root structure; the pulp may or may not be exposed. Additional findings may include loose, but still attached, segments of the tooth. Sensibility testing is usually positive.	As in root fractures, more than one radiographic angle may be necessary to detect fracture lines in the root. (See Introduction for radiographic recommendations).	Treatment recommendations are the same as for complicated crown fractures (See above). In addition, attempts at stabilizing loose segments of the tooth by bonding may be advantageous, at least as a temporary measure, until a definitive treatment plan can be formulated.

Root Fracture

Clinical findings	Radiographic findings	Treatment
The coronal segment may be mobile and may be displaced. The tooth may be tender to percussion. Sensibility testing may give negative results initially, indicating transient or permanent pulpal damage; monitoring the status of the pulp is recommended. Transient crown discoloration (red or grey) may occur.	The fracture involves the root of the tooth and is in a horizontal or diagonal plane. Fractures that are in the horizontal plane can usually be detected in the regular 90° angle film with the central beam through the tooth. This is usually the case with fractures in the cervical third of the root. If the plane of fracture is more diagonal, which is common with apical third fractures, an occlusal view is more likely to demonstrate the fracture including those located in the middle third.	Reposition, if displaced, the coronal segment of the tooth as soon as possible. Check position radiographically. Stabilize the tooth with a flexible splint for 4 weeks. If the root fracture is near the cervical area of the tooth, stabilization is beneficial for a longer period of time (up to 4 months). It is advisable to monitor healing for at least one year to determine pulpal status. If pulp necrosis develops, root canal treatment of the coronal tooth segment to the fracture line is indicated to preserve the tooth.

Alveolar Fracture

Clinical findings	Radiographic findings	Treatment
The fracture involves the alveolar bone and may extend to adjacent bone.	Fractures lines may be located at any level, from the marginal bone to the	Reposition any displaced segment and then splint. Stabilize the segment for 4 weeks.

Segment mobility and dislocation are common findings. An occlusal change due to misalignment of the fractured alveolar segment is often noted. Sensibility testing may or may not be positive.	root apex. The panoramic technique is of great help in determining the course and position of fracture lines.	
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Follow-up procedures for fractured permanent teeth and alveolar fractures

Time	4 weeks	6-8 weeks	4 months	6 months	1 year	5 years
Uncomplicated crown fracture		C(1)			C(1)	
Complicated crown fracture		C(1)			C(1)	
Crown-root fracture		C(1)			C(1)	
Root fracture	S + C(2)	C(2)	S(*) + C(2)	C(2)	C(2)	C(2)
Alveolar fracture	S + C(3)	C(3)	C(3)	C(3)	C(3)	C(3)

S= Splint removal

S (*) = Splint removal in cervical third fractures

C= Clinical and radiographic examination.

Favorable and Unfavorable Outcomes include some, but not necessarily all of the following:

	Favorable Outcome	Unfavorable Outcome
(1)	Asymptomatic; positive response to pulp testing; continuing root development in immature teeth. Continue to next evaluation.	Symptomatic; negative response to pulp testing; signs of apical periodontitis; no continuing root development in immature teeth. Root canal treatment is indicated.
(2)	Positive response to pulp testing (false negative possible up to 3 months). Signs of repair between fractured segments. Continue to next evaluation.	Negative response to pulp testing (false negative possible up to 3 months). Clinical signs of periodontitis. Radiolucency adjacent to fracture line. Root canal treatment is indicated only to the line of fracture.
(3)	Positive response to pulp testing (false negative possible up to 3 months). No signs of apical periodontitis. Continue to next	Negative response to pulp testing (false negative possible up to 3 months). Signs of apical periodontitis or external inflammatory

evaluation.

resorption. Root canal treatment is indicated.

2. Treatment Guidelines for Luxation Injuries

Concussion

Clinical findings	Radiographic findings	Treatment
The tooth is tender to touch or tapping; it has not been displaced and does not have increased mobility. Sensibility tests are likely to give positive results.	No radiographic abnormalities.	No treatment is needed. Monitor pulpal condition for at least one year.

Subluxation

Clinical findings	Radiographic findings	Treatment
The tooth is tender to touch or tapping and has increased mobility; it has not been displaced. Bleeding from gingival crevice may be noted. Sensibility testing may be negative initially indicating transient pulpal damage. Monitor pulpal response until a definitive pulpal diagnosis can be made.	Radiographic abnormalities are usually not found.	A flexible splint to stabilize the tooth for patient comfort can be used for up to 2 weeks.

Extrusive luxation

Clinical findings	Radiographic findings	Treatment
The tooth appears elongated and is excessively mobile.	Increased periodontal ligament space apically.	Reposition the tooth by gently re-inserting it into the tooth socket. Stabilize the tooth for 2 weeks using a flexible splint.

Sensibility tests will likely give negative results. In mature teeth, pulp revascularization sometimes occurs. In immature, not fully developed teeth, pulpal revascularization usually occurs.	Monitoring the pulpal condition is essential to diagnose root resorption. In immature developing teeth, revascularization can be confirmed radiographically by evidence of continued root formation and pulp canal obliteration and usually return to positive response to sensibility testing. In fully formed teeth, a continued lack of response to sensibility testing should be taken as evidence of pulp necrosis together with periapical rarification and sometimes crown discoloration.
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Lateral luxation

Clinical findings	Radiographic findings	Treatment
The tooth is displaced, usually in a palatal/lingual or labial direction. It will be immobile and percussion usually gives a high, metallic (ankylosed) sound. Sensibility tests will likely give negative results. In immature, not fully developed teeth, pulpal revascularization usually occurs.	The widened periodontal ligament space is best seen on eccentric or occlusal exposures.	Reposition the tooth with forceps to disengage it from its bony lock and gently reposition it into its original location. Stabilize the tooth for 4 weeks using a flexible splint. Monitor the pulpal condition. If the pulp becomes necrotic, root canal treatment is indicated to prevent root resorption. In immature, developing teeth, revascularization can be confirmed radiographically by evidence of continued root formation and possibly by positive sensibility testing. In fully formed teeth, a continued lack of response to sensibility testing indicates pulp necrosis, along with periapical rarification and sometimes crown discoloration.

Intrusive luxation

Clinical findings	Radiographic findings	Treatment
The tooth is displaced axially into the alveolar bone. It is immobile and percussion may give a	The periodontal ligament space may be absent from all or part of the root.	1. Teeth with incomplete root formation: Allow spontaneous repositioning to take place. If no movement is noted within 3 weeks, recommend rapid orthodontic

high, metallic (ankylosed) sound. Sensitivity tests will likely give negative results. In immature, not fully developed teeth, pulpal revascularization may occur.	repositioning. 2. Teeth with complete root formation: The tooth should be repositioned either orthodontically or surgically as soon as possible. The pulp will likely be necrotic and root canal treatment using a temporary filling with calcium hydroxide is recommended to retain the tooth.
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Follow-up procedures for luxated permanent teeth

Time	up to 2 weeks	4 weeks	6-8 weeks	6 months	1 year	Yearly for 5 years
Concussion/ Subluxation		C(1)	C(1)		C(1)	NA
Extrusive luxation	S+C (2)	C(3)	C(3)	C(3)	C(3)	C(3)
Lateral luxation	C(3)	S	C(3)	C(3)	C(3)	C(3)
Intrusive luxation	C(4)		C(4)	C(4)	C(4)	C(4)

S= Splint removal

C= Clinical and radiographic examination.

NA= Not applicable

Favorable and Unfavorable Outcomes include some, but not necessarily all of the following:

	Favorable Outcome	Unfavorable Outcome
(1)	Asymptomatic; positive response to pulp testing (false negative possible up to 3 months); continuing root development in immature teeth; intact lamina dura.	Symptomatic; negative response to pulp testing (false negative possible up to 3 months); no continuing root development in immature teeth, periradicular radiolucencies.
(2)	Minimal symptoms; slight mobility; no excessive radiolucency periradicularly.	Severe symptoms; excessive mobility; clinical and radiographic signs of periodontitis. Root canal treatment is indicated in a closed apex tooth. In immature teeth, apexification procedures are indicated.
(3)	Asymptomatic; clinical and radiographic signs of normal or healed periodontium; positive response to pulp testing (false negative possible up to 3 months). Marginal bone height corresponds to that seen	Symptoms and radiographic sign consistent with periodontitis; negative response to pulp testing (false negative possible up to 3 months); breakdown of marginal bone. Splint for additional 3-4 week period; root canal treatment

	radiographically after repositioning.	is indicated if not previously initiated; chlorhexidine mouth rinse.
(4)	Tooth in place or erupting; intact lamina dura; no signs of resorption. In mature teeth start the root canal treatment within the first three weeks.	Tooth locked in place / ankylotic tone; radiographic signs of apical periodontitis; external inflammatory resorption or replacement resorption.

3. Treatment guidelines for avulsed permanent teeth

Tooth with a closed apex

- The tooth has already been replanted
- The tooth has been kept in special storage media (Hank's Balanced Salt Solution), milk, saline, or saliva.

The extra-oral dry time is less than 60 minutes

- Extra-oral dry time longer than 60 minutes

Tooth with open apex

- The tooth has already been replanted
- The tooth has been kept in special storage media (Hank's Balanced Salt Solution), milk, saline, or saliva.

The extra-oral dry time is less than 60 minutes

- Extra-oral dry time longer than 60 minutes

Treatment guidelines for avulsed permanent teeth with closed apex

Clinical situation (3.1a)	Treatment
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Closed apex The tooth has been replanted prior to the patient arriving in the dental office or clinic.	Clean the area with water spray, saline or chlorhexidine. Do not extract the tooth. Suture gingival lacerations if present. Verify normal position of the replanted tooth both clinically and radiographically. Apply a flexible splint for up to 2 weeks. Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients. (In many countries tetracycline is not recommended for patients under 12 years of age). In young patients Phenoxymethyl Penicillin (Pen V), in an appropriate dose for age and weight, can be given as alternative to tetracycline. If the avulsed tooth has contacted soil, and if tetanus coverage is uncertain, refer to physician for evaluation and need for a tetanus booster. Initiate root canal treatment 7 to 10 days after replantation and before splint removal. Place calcium hydroxide as an intra-canal medicament until filling of the root canal. Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0,1%) mouth rinse twice a day for 1 week. Follow-up See 'Follow-up procedures for avulsed permanent teeth' below.
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Clinical situation (3.1b)	Treatment
Closed apex The tooth has been kept in special storage media (Hank's Balanced Salt Solution), milk, saline, or saliva. The extra-oral dry time is less than 60 minutes	If contaminated, clean the root surface and apical foramen with a stream of saline and place the tooth in saline. Remove the coagulum from the socket with a stream of saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument. Replant the tooth slowly with slight digital pressure. Suture gingival lacerations. Verify normal position of the replanted tooth both clinically and radiographically. Apply a flexible splint for up to 2 weeks. Administer systemic antibiotics. Tetracycline is the first choice (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). The risk of discoloration of permanent teeth must be considered before systemic administration of tetracycline in young patients. (In many countries tetracycline is not recommended for patients under 12 years of age). In young patients Phenoxymethyl Penicillin (Pen V), at appropriate dose for age and weight, can be given as alternative to

tetracycline.

If the avulsed tooth has contacted soil, and if tetanus coverage is uncertain, refer the patient to a physician for evaluation and need for a tetanus booster.

Initiate root canal treatment 7 to 10 days after replantation and before splint removal. Place calcium hydroxide as an intra-canal medicament until filling of the root canal.

Patient instructions

Soft diet for up to two weeks.

Brush teeth with a soft toothbrush after each meal.

Use a chlorhexidine (0,1%) mouth rinse twice a day for 1 week.

Follow-up

See '[Follow-up procedures for avulsed permanent teeth](#)' below.

Clinical situation (3.1c)	Treatment
Closed apex Extra-oral dry time longer than 60 minutes	Delayed replantation has a poor long term prognosis. The periodontal ligament will be necrotic and not expected to heal. The goal in doing delayed replantation is to promote alveolar bone growth to encapsulate the replanted tooth. The expected eventual outcome is ankylosis and resorption of the root. In children below the age of 15, if ankylosis occurs, and when the infraposition of the tooth crown is more than 1mm, it is recommended to perform decoronation to preserve the contour of the alveolar ridge. The technique for delayed replantation is: 1. Remove attached necrotic soft tissue with gauze. 2. Root canal treatment can be done on the tooth prior to replantation, or it can be done 7-10 days later as for other replantations. 3. Remove the coagulum from the socket with a stream of saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument. 4. Immerse the tooth in a 2% sodium fluoride solution for 20 minutes 5. Replant the tooth slowly with slight digital pressure. Suture gingival laceration. Verify normal position of the replanted tooth clinically and radiographically. 6. Stabilize the tooth for 4 weeks using a flexible splint. Administration of systemic antibiotics, see 3.1b. Refer to physician for evaluation of need for a tetanus booster if the avulsed tooth has contacted soil or tetanus coverage is uncertain. Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0,1%) mouth rinse twice a day for 1 week.

	Follow-up See ' Follow-up procedures for avulsed permanent teeth ' below.
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Treatment guidelines for avulsed permanent teeth with open apex

Clinical situation (3.2a)	Treatment
Open Apex The tooth has already been replanted prior to the patient arriving in the dental office or clinic.	Clean the area with water spray, saline or chlorhexidine. Do not extract the tooth. Suture gingival lacerations if present. Verify normal position of the replanted tooth both clinically and radiographically. Apply a flexible splint for up to 2 weeks. Administer systemic antibiotics. For children 12 years and younger: Penicillin V at an appropriate dose for patient age and weight. For children older than 12 years of age, where there is little risk for tetracycline discoloration: Tetracycline (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). Refer the patient to a physician for evaluation of need for a tetanus booster if avulsed tooth has contacted soil or tetanus coverage is uncertain. The goal for replanting still-developing (immature) teeth in children is to allow for possible revascularization of the tooth pulp. If that does not occur, root canal treatment may be recommended – see 'Follow-up procedures for avulsed permanent teeth' below. Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0,1%) mouth rinse twice a day for 1 week. Follow-up See 'Follow-up procedures for avulsed permanent teeth' below.

Clinical situation (3.2b)	Treatment
Open Apex The tooth has been kept in special storage media (Hank's Balanced Salt Solution), milk, saline, or saliva. The extra-oral dry time is less than 60 minutes	If contaminated, clean the root surface and apical foramen with a stream of saline. Remove the coagulum from the socket with a stream of saline and then replant the tooth. If available, cover the root surface with minocycline hydrochloride microspheres (Arestin™, OraPharma Inc.) before replanting the tooth. Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument. Replant the tooth slowly with slight digital pressure. Suture gingival lacerations, especially in the cervical area. Verify normal position of the replanted tooth clinically

	and radiographically. Apply a flexible splint for up to 2 weeks. Administer systemic antibiotics. For children 12 years and younger: Penicillin V at appropriate dose for patient age and weight. For children older than 12 years of age, where there is little risk for tetracycline discoloration: Tetracycline (Doxycycline 2x per day for 7 days at appropriate dose for patient age and weight). Refer to physician for evaluation of need for a tetanus booster if avulsed tooth has contacted soil or tetanus coverage is uncertain. The goal for replanting still-developing (immature) teeth in children is to allow for possible revascularization of the tooth pulp. If that does not occur, root canal treatment may be recommended – see ‘Follow-up procedures for avulsed permanent teeth’ below. Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0,1%) mouth rinse twice a day for 1 week. Follow-up See ‘Follow-up procedures for avulsed permanent teeth’ below.
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Clinical situation (3.2c)	Treatment
Open Apex Extra-oral dry time longer than 60 minutes	Delayed replantation has a poor long-term prognosis. The periodontal ligament will be necrotic and not expected to heal. The goal in doing delayed replantation of immature teeth in children is to maintain alveolar ridge contour. The eventual outcome is expected to be ankylosis and resorption of the root. It is important to recognize that if delayed replantation is done in a child, future treatment planning must be done to take into account the occurrence of tooth ankylosis and the effect of ankylosis on the alveolar ridge development. If ankylosis occurs, and when the infraposition of the tooth crown is more than 1mm, it is recommended to perform decoronation to preserve the contour of the alveolar ridge. The technique for delayed replantation is: 1. Remove attached necrotic soft tissue with gauze. 2. Root canal treatment can be done on the tooth prior to replantation through the open apex. 3. Remove the coagulum from the socket with a stream of saline. Examine the alveolar socket. If there is a fracture of the socket wall, reposition it with a suitable instrument. 4. Immerse the tooth in a 2% sodium fluoride solution for 20 minutes 5. Replant the tooth slowly with slight digital pressure. Suture gingival laceration. Verify normal position of the replanted tooth clinically and radiographically.

	6. Stabilize the tooth for 4 weeks using a flexible splint. Administration of systemic antibiotics, see 3.1b. Refer the patient to a physician for evaluation of need for a tetanus booster if the avulsed tooth has contacted soil or tetanus coverage is uncertain. Patient instructions Soft diet for up to two weeks. Brush teeth with a soft toothbrush after each meal. Use a chlorhexidine (0,1%) mouth rinse twice a day for 1 week. Follow-up See 'Follow-up procedures for avulsed permanent teeth' below.
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Follow-up procedures for avulsed permanent teeth

Root canal treatment

If root canal treatment is indicated (teeth with closed apex), the ideal time to begin treatment is 7-10 days post-replantation. Calcium hydroxide is recommended for intra canal medication for up to one month followed by root canal filling with an acceptable material. An exception is a tooth that has been dry for more than 60 minutes before replantation – in such cases the root canal treatment may be done prior to replantation.

In teeth with open apices, that have been replanted immediately or kept in appropriate storage media, pulp revascularization is possible. Root canal treatment should be avoided unless there is clinical and radiographic evidence of pulp necrosis.

Clinical control

Replanted teeth should be monitored by frequent controls during the first year (once a week during the first month, 3, 6, and 12 months) and then yearly thereafter. Clinical and radiographic examination will provide information to determine outcome. Evaluation may include the findings described below.

Favorable outcome

1. Closed apex: Asymptomatic, normal mobility, normal percussion sound. No radiographic evidence of resorption or periradicular osteitis; the lamina dura should appear normal.
2. Open apex: Asymptomatic, normal mobility, normal percussion sound. Radiographic evidence of arrested or continued root formation and eruption. Pulp canal obliteration is the rule.

Unfavorable outcome

1. Closed apex: Symptomatic, excessive mobility or no mobility (ankylosis) with high pitched percussion sound. Radiographic evidence of resorption (inflammatory, infection-related resorption, or ankylosis-related replacement resorption).
2. Open apex: Symptomatic, excessive mobility or no mobility (ankylosis) with high pitched percussion sound. In the case of ankylosis, the crown of the tooth will appear to be in an infra-occlusal position. Radiographic evidence of resorption (inflammatory, infection-related resorption, or ankylosis-related replacement resorption).

Splinting guidelines for tooth/bone fractures and luxated/avulsed teeth

A. Splinting times

Type of injury	Splinting time
Subluxation	2 weeks
Extrusive luxation	2 weeks
Avulsion	2 weeks
Lateral luxation	4 weeks
Root fracture (middle third)	4 weeks
Alveolar fracture	4 weeks
Root fracture (cervical third)	4 months

B. Type of splints

1. Wire-composite splint
2. TTS (Titanium trauma splint)
3. Unfilled resin (Protemp®, Luxatemp®, Isotemp®, Provipond®)

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